E&A

U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1503

IMP. BUR.
21 JAN 1927
ENTOM.

The HORSE BOTS AND THEIR CONTROL

THREE KINDS OF HORSE BOTS cause considerable loss to farmers and horse breeders in the United States. The annoyance of the flies during egg laying is serious, especially that of the nose botfly, which often makes horses uncontrollable. Although the nose bot is restricted to the North Central and the northern Rocky Mountain States, it is gradually spreading, and steps should be taken to control it. Horse bots require about a year for development, and during this time remain attached to the stomach and intestine and not only interfere with digestion but may actually cause stoppage, resulting in death.

A strip of belting suspended beneath the lips of the horse simply and effectively reduces annoyance from the nose botfly, and a special protector has been devised for use on horses on pasture. The internal treatment of all horses and colts in December or January with carbon disulphide, and at the same time the application of a carbolic wash to destroy the eggs, will control all three kinds of bots. For the best results and to avoid injury this treatment must be properly administered. Suggestions for control or eradication of horse bots by community effort are also outlined in this bulletin.

Washington, D. C. Issued September, 1926

THE HORSE BOTS AND THEIR CONTROL

By F. C. Bishopp, *Entomologist, in charge,* and W. E. Dove, *Assistant Entomologist, Investigations of Insects Affecting the Health of Animals, Bureau of Entomology*

CONTENTS

	Page		Page
Kinds of botflies and where they occur	1	How to combat horse bots—Contd. Protective devices	9
How horse bots cause loss	2	Removal of nose bots from the rectum	11
Seasonal history	5	Destruction of botfly eggs	11
Life history and habits	5	Administration of carbon disulphide to horses for the destruction of bots	12
Factors which control botflies in nature	8	Community effort in bot control	13
How to combat horse bots	9		
Use of repellents	9		

CONTROL of horse bots has been given very little attention until recently, when a species known as the nose fly, new to this country, began to spread over the North Central States. The very acute annoyance of this invader has caused many horse raisers and farmers to give thought to the question of bringing about control, if possible, of all kinds of horse bots. Investigations made a few years ago by the junior author and by M. C. Hall, of the Bureau of Animal Industry, clearly point to a very effective and economical treatment for the control or even eradication of these troublesome parasites. Practically everyone having anything to do with horses is more or less familiar with horse bots, and, though this familiarity tends to breed contempt, all close observers of these parasites realize their seriousness.

KINDS OF BOTFLIES AND WHERE THEY OCCUR

There are three distinct species of horse bots in the United States, the largest and most widely distributed being known as the common botfly or nit fly. This species [1] varies considerably in abundance but is present in practically all parts of the United States. It is the least annoying of the three species at the time its eggs are laid, since it places most of them on the hairs of the legs. The fly hovers about the horse and is comparatively easy to capture or kill. Its body is covered with bands of black and yellow hair, and each of its wings bears a dark-colored band.

The so-called chin fly, or throat botfly,[2] is almost as widely distributed, and is especially abundant in the Rocky Mountain region. This fly is much more annoying than the common botfly, as it lays its eggs principally under the jaws of the horse, causing the animal

[1] Known scientifically as *Gastrophilus intestinalis* De Geer, and formerly known as *G. equi.*

[2] *Gastrophilus nasalis* L.

to throw its head violently and sometimes to strike with the forefeet. This fly is smaller than the common botfly, the wings are free from markings, and the flight is more rapid, except when the insect poises in mid-air preparatory to striking the animal under the jaw.

The nose fly[3] is confined principally to the North Central and certain of the Rocky Mountain States, but is gradually spreading in all directions (fig. 1). It is the smallest of the three species, and is darker in color than the others, most of the hair on its body being black. The abdomen, however, has a distinct yellow band across its base and a bright orange tip. The wings are free from markings.

HOW HORSE BOTS CAUSE LOSS

Extreme annoyance is caused during egg laying, the "nose botfly" being the greatest offender. None of these botflies sting, but the

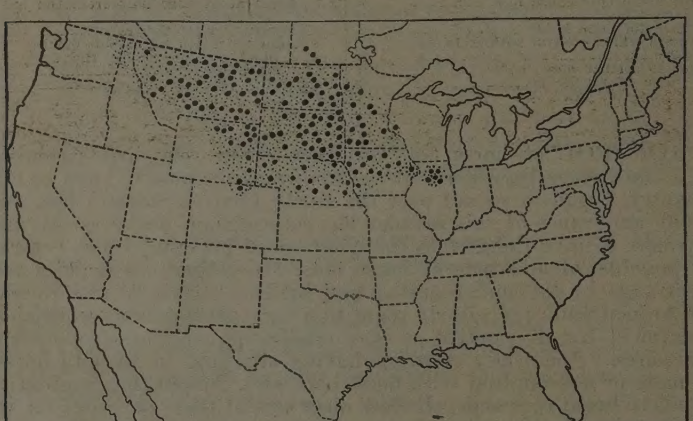

FIG. 1.—Map showing distribution of the nose botfly in the United States. The large dots indicate localities from which the insect has been reported; small dots indicate its probable distribution

horse's instinctive fear of them and the tickling of the insect as it attaches its eggs to the hair on the edge of the lip causes the most docile animal to become absolutely uncontrollable at times. Whatever the species of the botfly, the degree of annoyance when the eggs are laid depends to some extent upon the temperament of the horse attacked. During the days of sunshine which are favorable for the activity of this fly, horses are fighting from early morning until late afternoon, and are unable to feed, even for short periods.

The actions of pastured horses in seeking protection are very characteristic. They will come together in shade or upon high ground where the wind blows, and will stand in positions calculated to protect them from attack. The presence of nose botflies is indicated when they rest their lips upon each others' backs (fig. 2); and if the throat botfly is causing the annoyance they place their heads over

[3] *Gastrophilus haemorrhoidalis* L.

each other so as to protect the jaws (fig. 3). If they have an opportunity horses will enter the barns or other places where they are not disturbed by the flies. Frequently they stand at watering tanks, and when attacked by nose botflies they will dip their lips into the

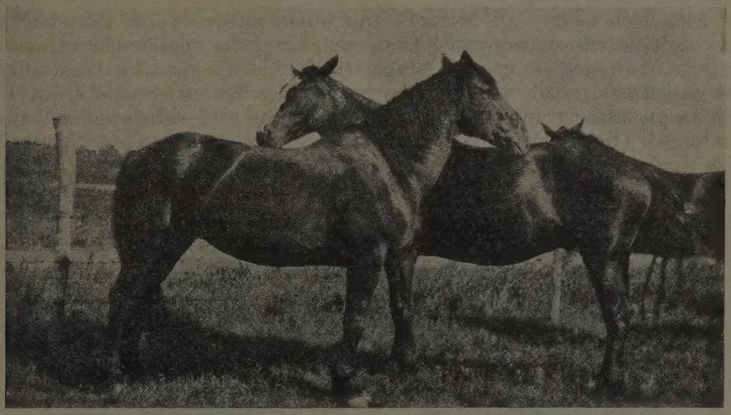

FIG. 2.—Horses protecting their lips from nose botflies

water, then rub them violently against the wall of the tank. If sufficient protection is not obtained in some portion of the pasture, they walk about in search of places more favorable for natural protection. While so doing they constantly raise and lower the head, apparently nodding. This action does not always prevent the flies

FIG. 3.—Horses protecting their jaws from throat botflies

from depositing eggs, and when it fails the horses run from the flies. The horses usually run much faster than the colts, with the result that the colts are heavily attacked, but at times the colts avoid the flies to a considerable extent by lying down near older horses. Fre-

quently the lips are rubbed violently on the ground, on barbed wire fences, or on other objects, producing cuts and bruises. Horses in harness, unless protected from the flies, often can not be controlled. Often men are injured by the striking of the animals, and runaways are not uncommon.

Although nearly all farmers and horse raisers know that botflies laying eggs cause annoyance to horses, few fully realize the injurious effects of the bot or maggot stage while it is attached to the stomach or intestines. For several months, during which the bots develop from an almost microscopic size to about two-thirds of an inch in length (fig. 4) these parasites may be doing great harm. Naturally the degree of injury to the animal depends upon the number of bots present, and to some extent upon the species concerned; also upon

FIG. 4.—Portion of horse's stomach, with bots and lesions caused by them

the animal's susceptibility, which in turn is influenced by its condition.

Numerous cases have been observed in which bots were attached in the duodenum, leading from the stomach, in such a way as to hinder seriously the passage of food. Very commonly several hundred bots may be found in a single animal, and over 1,000 of them have been taken out of the stomach of a colt at one time. The attachment of even a few of these spiny bots to the lining of the stomach and intestines furnishes points where inflammatory processes are set up, causing more or less interference with digestion, and this effect is multiplied when the bots are very numerous (fig. 4). The nose-fly bots also attach themselves in the rectum and on the edge of the anus before they drop to the ground. While attached they are very annoying, and horses have been known to dislocate the bones of the tail in attempts to rub the affected parts.

In its earlier stages the throat bot has the habit of attaching itself in the throat or pharynx, and when numerous it may cause considerable irritation and swelling. In one case on record, observed by a veterinarian in Iowa, a mare died from these bots in the throat. For more than a month the animal had difficulty in eating and finally became unable to swallow food or water.

In certain sections where control work against horse bots has been in progress, many farmers declare that the number of cases of colic and other digestive disturbances has been greatly reduced, and that horses are kept in better flesh on the same feed than was possible before the control work began.

SEASONAL HISTORY

The adults of the three kinds of horse bots are active at about the same time of the year, but in South Dakota the nose botfly is the first to be observed. The common horse botflies appear in that section somewhat earlier in the summer than they do in the Southern States, but this period of activity is ended by killing frosts about October 1. The flies of this species are seldom seen in the South before August 1, although in western Texas they occasionally appear in April. In southern Texas they may be observed until the latter part of December. This is also practically true of the throat botfly. In the Northern States these two species often begin to appear by the first of July, but they always become more numerous and troublesome to horses later in the fall. They are frequently very troublesome in warm periods following the first frosts, but disappear after a heavy freeze. In South Dakota and eastern Montana it has been found that the adults of the nose botfly may begin to appear shortly after the middle of June, and that they usually reach their maximum in July and the early part of August, the number diminishing greatly in the fall, when the two other kinds of botflies are most numerous.

The seasonal occurrence of the eggs on horses is the same as that of the flies, except that in the case of the common horse bot the young maggots may remain alive in the eggs for several months. In South Dakota active larvæ have been found in eggs collected from horses on pasture as late as December 1. At Dallas, Tex., active maggots were found in eggs on horses as late as February 23.

Bots may be found in the digestive tracts of horses at any time during the year, but usually all of the mature bots have passed out by October 1. At that time and throughout the early part of winter practically none but young bots are to be found. These are points of much importance in connection with control, and will be mentioned later.

LIFE HISTORY AND HABITS

In the life history of each of the three kinds of horse bots in this country, the bot or maggot spends from 8 to 12 months, or even longer, as a parasite in the digestive tract of the horse. Some of the differences in the egg-laying habits of the three species have been mentioned, but it is desirable to stress further certain points in the life processes of each.

All of the botflies are supplied with enough food from the maggot stage to enable them to develop and deposit their eggs without par-

taking of food. In fact, the sole purpose in life of these flies is reproduction, and they do not have mouth parts adapted for feeding. Their lives are very short, lasting from a few days to about three weeks. The common botfly seems to live longest; the writers have recorded for this species a maximum longevity of 21 days. It is doubtful if, in warm weather, it ever lives longer than 10 days. The throat botfly lives from 3 to 12 days, and the nose botfly from 3 to 6 days. The females of the throat botfly and of the common botfly usually lay from 300 to 500 eggs each. The nose botfly is less prolific, the usual number of eggs which it is capable of laying being about 150.

In laying eggs, the common botfly usually remains about the horse almost continuously, flying from place to place as it cements egg after egg to the hairs. The abdomen is curved under in a characteristic shape and the attachment of each egg takes but a second. Several eggs may be laid at one time, as the fly settles for an instant on the horse. The inner side of the knee appears to be the favorite place for attaching the eggs, but many are laid on the outside of the forelegs, on the shoulders, belly, neck, and flanks, and some on the hind quarters.

The throat botfly flies more rapidly than the species last named; it usually poises in mid-air between or near the forelegs of the horse, then darts at the throat. From one to four eggs seem to be laid at one time, attached singly to the hairs, the number depending on how quickly the fly is dislodged by the horse. After an attack the insect flies rapidly away, only to appear again in a few minutes and renew its attentions with undiminished vigor. Occasionally, but not usually, it will lay an egg on the hairs of the legs, shoulders, or flanks.

The flight of the nose botfly is even more rapid than that of the throat botfly. The female darts at the lips, deposits a single egg, then flies away for a few seconds, and again strikes the horse if the lips are not protected. The fly lays its eggs only around the muzzle, and, contrary to the belief of many, does not enter the nose.

The eggs of all three of the botflies are attached to hairs on the animal, the shape and color of the eggs varying considerably, as indicated in Figure 5. The egg of the common botfly is pale yellow in color, and is attached to the hair along its basal third, the free end of the egg slanting distinctly away from the hair to which it is attached. Often several eggs of this species are fastened to the same hair, especially when it is on the long hair of the mane. In shape the egg of the throat botfly differs slightly from this, and it is attached to the hair along more than two-thirds of its length, its free end diverging but little from the hair bearing it. The egg of the nose botfly is black and it is drawn out at its lower end into a peculiar stalk, rough and closely clamped around a very short fine hair on the lips. The stalk, attached to the shaft of the hair, enters the pit or follicle from which the hair arises, thus giving the impression that it is stuck into the skin.

The eggs of the common botfly do not hatch until they are rubbed or licked by the horse. The minute spiny maggots are ready for emergence from the egg in about seven days, but may lie dormant for several months. The horse in biting itself completes the

hatching; the young bots are taken into the mouth and find their way to the stomach, to the walls of which they attach themselves.

It is not definitely known how the maggots of the throat botfly get into the animal. As has been stated, the eggs are mostly deposited under the jaws, attached singly to the hairs, and usually very close to the skin. It has been found that the newly hatched maggots can burrow into the mucous membranes of the mouth, and it is possible that they may be able to work their way through the skin beneath the jaws. The eggs of this species will hatch without friction or moisture, and on examining them not long after they are laid, the writers have never found living larvæ within them. In some way the young bots find their way to the stomach, or occasionally attach themselves to the pharynx. Many of the bots of this species, however, pass through the stomach and find attachment in the first section of the intestine. The throat bots adhering to the stomach are to be found mainly in the pyloric or exit end of the stomach; the common bots attach themselves to the white covering of the left sac, or along the ridge between the right and left sacs. The throat bots, especially when nearly grown, are paler than the common bots, the latter often having a reddish color.

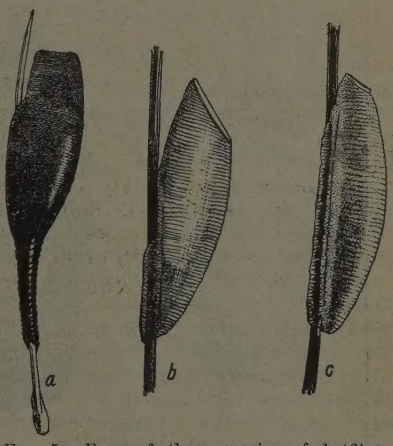

FIG. 5.—Eggs of three species of botflies; *a*, Nose-bot egg on hair removed with root; *b*, common horse-bot egg; *c*, throat-bot egg. Greatly enlarged.

The nose botfly lays its eggs preferably on the edges of the lips of the horse, where they are moistened by saliva. The eggs nearest the edge have been observed to disappear first, usually in 5 or 6 days, whereas those an inch away may remain for 18 days. Those attached some distance from the edges of the lips usually do not hatch. The eggshells do not remain attached long after hatching has occurred. The moisture and friction experienced by those laid near the edges of the lips hasten the hatching process, and it seems almost certain that the young maggots enter the mouth by their own action or with the food and water. The bots of this species attach themselves to various parts of the stomach, but are most abundant in that portion toward the exit. Some are also to be found in the first or duodenal section of the intestine. Unlike the bots of the other two species, however, some time before maturity the nose bots let go their hold on the walls of the stomach or upper intestine and pass back into the rectum, where they again attach themselves. There seems to be a strong tendency toward a final reattachment in the anus, where the bots remain for two or three days while they become accustomed to the air. The nose bots release their hold and drop off the anus at any time and are not normally passed with the dung. The other two species pass out with the dung and are usually not noticed by the casual observer.

The bots of these three species, in the last stage of development, may be readily distinguished not only by the differences in the place of attachment, as described above, but by the spiny armature on the body rings, better seen with a magnifying glass. These differences are indicated in Figure 6. Of the three species, when full grown, the common bot is the largest.

The exact nature of the food taken by the bots in the digestive tract of the horse is not known, but it is certain that they live to some extent at the expense of the host. The color of some of the bots, especially when young, is distinctly reddish, indicating that they may partake of blood. When mature, the throat bots are dirty white or yellowish in color; the nose bots are pinkish until just before dropping from the animal, when they show a distinct greenish tint; and the common bots are yellowish, sometimes with a decided pink tinge.

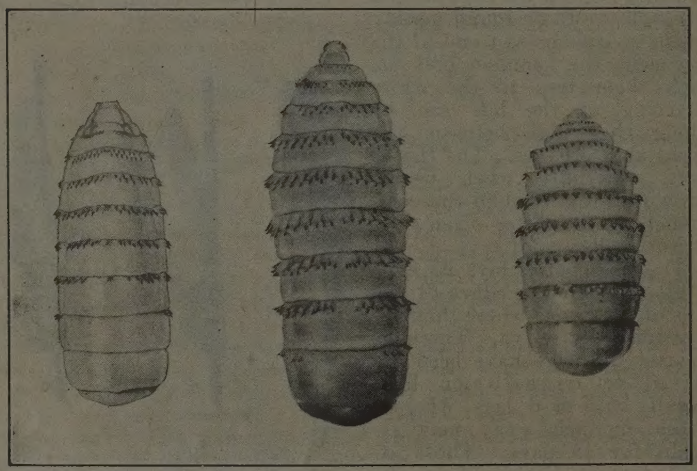

FIG. 6.—Full-grown larvæ of the three species of horse bots: At left, nose bot; in center, common bot; at right, throat bot

Whatever the species, there is a tendency for the bots when they reach the ground to seek some protection. They crawl very little, and usually burrow into the soil only a sufficient depth to escape from the direct rays of the sun. When the bots are buried artificially, they always work their way up to a point near the surface before changing to the pupa or resting stage. In from one to three or four days the outer skin hardens and forms a protective covering in which the change takes place from the bot to the fly. This pupa case is similar in shape to the bot, but varies in color from brown to black. The duration of the pupa or resting stage, according to temperature, is from 20 to 70 days, with no striking differences between the species.

FACTORS WHICH CONTROL BOTFLIES IN NATURE

It is certain that some of the bots which gain entrance to the digestive tract of the horse die and pass out before they mature, but

it appears that the death rate within the animal is comparatively low. When the bots drop to the ground, however, they are exposed to various natural enemies and to adverse climatic conditions. Farm fowls and birds dispose of many of them while in the maggot stage, and some are destroyed in the resting stage by fowls and mice. Many of the bots which drop on hard, dry ground, as along roads, are destroyed if the temperatures are very high, as they can not endure the excessive heat of the ground for more than a few minutes. They are also sensitive to excessive moisture during their resting period, and if kept continuously wet many of them die. Beyond doubt many of the bots which are covered deeply in manure piles perish from the heat of the manure. It appears from experiments that most of the bots which drop in fields and are immediately plowed under work their way to the surface before pupating, and successfully produce flies. The greater number of the bots of all species do not leave the horses when low temperatures are prevalent, and those passed at such times do not survive severe freezes.

HOW TO COMBAT HORSE BOTS

Some of the methods of control here outlined are applicable to all three species of bots; these are, of course, most important in regions where all of the species occur.

USE OF REPELLENTS

Many requests are received for suggestions as to what may be used to keep botflies away from work horses. Although the various species of botflies seem to be fairly sensitive to certain repellents, there is some practical difficulty in the way of their general adoption. In the first place, it is usually not feasible to keep all attacked parts covered with a repellent; this is especially true of the nose botfly. It is probable that, by using a repellent beneath the jaws and on the shoulders, forelegs, and flanks, animals may be protected to some extent from the throat botfly and common botfly, especially if only saddle horses and work horses are treated. The flies are thus forced to go to untreated animals or to deposit their eggs on portions of the animal to which the repellent has not been applied. The writers have found that for about four days after application a mixture of equal parts of pine tar and lard will keep the flies from laying eggs on the treated parts. They also obtained good results by applying to the hair of horses with a brush a mixture consisting of pine tar 3¾ ounces, kerosene 1¼ ounces, laundry soap 1 ounce, powdered resin 1 ounce, and hot water to make 14 ounces. The pine tar is thinned with the kerosene, the soap and resin are dissolved in hot water, and the two mixtures poured together. Too much dependence should not be placed on repellents, since they are at best only a means of lessening the annoyance caused by the flies, and of reducing the infestation of bots.

PROTECTIVE DEVICES

The use on horses of light blankets, nets, and the like tends to aid the animals in fighting botflies, but these devices do not afford adequate protection. In the case of horses in harness it is possible to prevent the deposition of eggs by the nose botfly and the throat bot-

fly, thus avoiding the great annoyance caused by these flies and eliminating the insect as an internal parasite. In regions where the nose botfly is well established the use of some sort of nose protector is imperative when horses are being worked or ridden. Certain devices have been tested for use on animals on pasture, but, on account of the difficulty of keeping them in good repair, they have not become generally adopted. One type developed and tested by the Bureau of Entomology (fig. 7) gave excellent protection against all three species of bots, seeming to lack only in durability; this defect might be overcome by a change of materials in its construction. The best results were found by making the mouth guard of half-inch hardwood boards. When the head is held up the lips are completely protected and the block beneath causes the mouth protector to swing back when the head is lowered and allow the animal to graze without interference. The throat is covered by duck, which, being attached to the back of the mouth protector, completely prevents attack from the throat botfly as well as from the nose botfly. Furthermore, this device prevents the animal from taking into the mouth the common bots while attempting to bite or scratch itself.

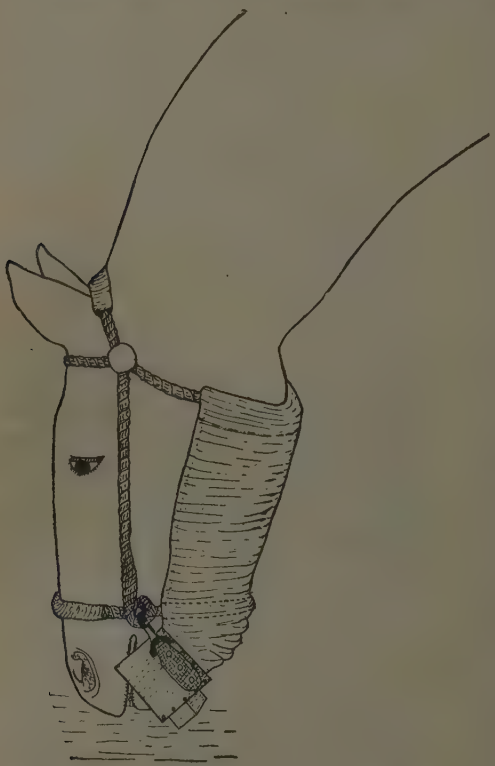

FIG. 7.—Device for protecting horses on pasture from infestation with bots

In regions where the nose botfly occurs, fringes of leather or burlap are used to a considerable extent about the noses of horses at work. These are objectionable, since they give partial protection only, and may interfere with breathing. Wire baskets placed over the horses' noses and attached to the bridles are popular, but are objectionable in that they become clogged and interefere with breathing, especially if the horses are being worked near the threshing machines or in other dusty places. If they are too near the lips they do not prevent the flies from laying eggs, and sometimes flies

actually get inside of them. One of the simplest, cheapest, and most effective protectors for use against the nose botfly consists of a piece of leather or belting about 4 to 6 inches wide, attached at each end to the bit rings by a string or snap so that the entire lips, including the corners, are protected. (Fig. 8). Many of these are now sold commercially, and are said to be highly satisfactory. A large degree of protection from the throat botfly can be secured by suspending under the jaws a piece of canvas or burlap, extending from the throat latch to the bit rings.

Probably the most dependable method of protecting horses on pasture against the attack of the nose botfly is to provide fairly deep sheds to which they may retreat when the flies are abroad, since this species does not enter very dense shade. This method will give some protection against the other two kinds of botflies, but less effectively, as these flies will sometimes pursue the animals to shaded places and lay their eggs there.

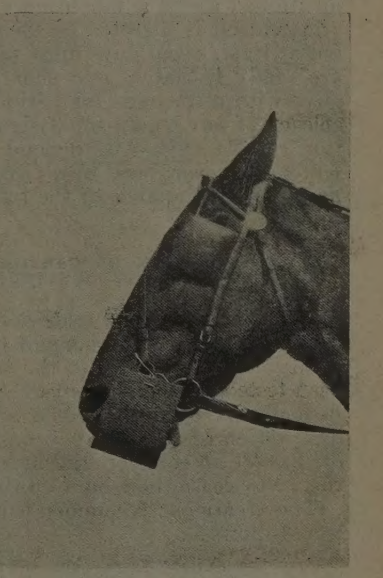

FIG. 8.—Device for protecting horses in harness from the attack of nose botflies

REMOVAL OF NOSE BOTS FROM THE RECTUM

Many horsemen have suggested the idea of mechanically removing the bots from the anus, or of administering enemas containing larvicides for the purpose of destroying them in the rectum. Because the bots are exposed for a short time only, and appear during the busy season, their mechanical removal has not been found successful. Much soreness about the anus is caused by pulling the bots off. The nose bots have been found very resistant to mild treatments administered in the form of enemas. Nicotine sulphate will destroy them, but on account of its poisonous properties its use is questionable.

DESTRUCTION OF BOTFLY EGGS

Practically all authors writing on the subject of horse bots have made suggestions as to the removal or destruction of the eggs. It is possible to effect a high degree of control by systematically applying washes which will kill the young larvæ in the eggs. In practice, however, this does not succeed, since some horses are nearly always on pasture during the fly season and are not regularly treated, and the thorough treatment of even the work animals at intervals of five or six days is rather laborious and likely to be neglected.

One of the old recommendations for destroying eggs was to apply kerosene oil lightly to the infested parts with a rag or brush. Tests carried out by the junior author have shown that kerosene will ac-

complish the destruction of very few of the eggs; its use is not therefore recommended.

A 2 per cent solution of any of the standard coal-tar creosote dips applied with a rag to the eggs on the hair will kill a very high percentage of them. A wash of carbolic acid containing 2 per cent phenols has given very good results. It is best to apply the solution with a mop consisting of a rag tied on a stick, and not to rub the materials in, which, if done repeatedly, will injure the skin on the hands and may slightly burn the horses.

Singeing the eggs with a torch and using clippers to remove them have been advocated by some. Although such treatments will destroy many of the young bots before hatching, the use of the dips mentioned above is much more thorough and is less laborious.

Attention is directed to the fact that, in the case of the common bot at least, seven days must pass after the eggs are laid before they are ready to hatch, and that many of the little bots may remain alive within the eggs for periods approximating three months. The efficacy of any treatment designed to control the pest by the destruction of the eggs will depend upon the frequency of application, which, however, need in no case be more than once in six days, and upon the continuance of the treatments as long as the flies are laying eggs.

ADMINISTRATION OF CARBON DISULPHIDE TO HORSES FOR THE DESTRUCTION OF BOTS

Investigations conducted a number of years ago in Italy showed that bots within horses could be destroyed by administering carbon disulphide in capsules to the infested animals. This treatment has been tested by the Bureau of Animal Industry and by veterinarians in many parts of the world and found to be very efficacious. The destruction of the bots is brought about by the action of the carbon disulphide in solution and as a gas, which poisons the bots, causing them to release their hold on the walls of the stomach and intestines.

The treatment recommended by the Bureau of Animal Industry is as follows:

Fast the animal from noon of the day preceding treatment until 6 or 7 o'clock of the next morning. At this time the animal is given carbon disulphide in gelatin capsules, the capsules being given by hand or by means of a balling gun. The dose for a horse weighing about 1,000 pounds is 1 dose of 6 drams, or 2 doses of 4 drams each with a 2-hour interval between doses, or 3 doses of 3 drams each with a 1-hour interval between doses. Do not feed or water for 3 hours after treatment. As a rule the single-dose treatment is most satisfactory, but if there is any question as to the animal's ability to tolerate the dose, divided doses may be given and the treatment suspended if bad effects follow a partial treatment. The dose should be diminished for smaller animals, and yearling colts should not receive over half the quantities given above. Very old or weak horses, or those suffering from febrile or debilitating diseases are sometimes poor risks for treatment. The carbon disulphide should not be followed by a purgative and oil is especially undesirable. Preliminary purgation the evening before treatment is only advisable in the case of a constipated animal. The bots may continue to pass out for over two weeks after treatment.

In view of the fact that carbon disulphide is a poison, intended to poison the bots, and one which may cause unpleasant results or even death if given unskillfully or administered to animals having disease conditions which make the treatment unsafe, it is always advisable to have the treatment given by a competent veterinarian whenever possible. Serious consequences have re-

sulted when poorly trained men used makeshift balling guns. When a capsule breaks in a horse's mouth and the carbon disulphide gets into the lungs, the horse may die.

A very important consideration in obtaining the best results is the matter of time of treatment. Carbon disulphide will remove many bots when administered at any time of the year, but the greatest efficiency can be obtained by treatment in winter months, preferably December or January. If treatment is administered before the botflies disappear in the fall the horses may become reinfested, or if it is delayed much after February 1 the bots will become resistant to the chemical. It has been found that some of the nose-fly bots begin, soon after this time, to pass backward into the rectum, where they can not be reached with the internal treatment. In the Southern States, January is the best month for treatment, as botflies may appear and lay eggs on horses in December. Another argument in favor of early winter treatment is that the horses by being freed from the parasites early will pass the winter in better condition.

In connection with the administration of carbon disulphide, a point of decided importance is the application of a wash, as previously described, to destroy the eggs. This wash should be very thoroughly applied to all parts of the animals where eggs occur, otherwise the young bots from them will be taken into the animal and reinfest the stomach.

It should be borne in mind also that although few bots may be seen to be passed as a result of the early winter treatment, they are nevertheless destroyed. At this time of year, because of their small size and reddish color, they are less conspicuous and are easily overlooked.

COMMUNITY EFFORT IN BOT CONTROL

In the last few years a number of communities have attempted bot control by systematic treatment of all donkeys, mules, horses, and colts. In no case has the work been thorough enough to justify hope of complete eradication, but the results as reported by the farmers in the areas treated have been most gratifying. Not only has annoyance from nose botflies and other botflies been greatly decreased after a single year's effort, but a general improvement has been reported in the condition and health of the horses.

It appears to be entirely feasible, especially in regions where there are very few horses on pasture, to eradicate horse bots by a combination of the carbon-disulphide treatment and the application of washes for the destruction of the eggs. For all except the extreme southern portion of the United States, December is the best month for this work. Along with the carbon-disulphide treatment every horse should be thoroughly washed with a 2 per cent coal-tar creosote dip, to destroy the young bots which remain dormant in the eggs. Any colt dropped before the last botflies have been killed by freezing temperatures is subject to infestation and should be treated along with the other horses if best results are to be obtained. In fact, colts may become slightly infested from the eggs on the dam, even after all botflies have disappeared in the fall.

It is theoretically possible to destroy all bots in an area where the work is thoroughly done, but in practice such results can hardly be expected. It is firmly believed, however, that by treating all horses, mules, and colts for two or three years complete eradication will be accomplished.

From an economical point of view there is every reason for giving the treatment properly and thoroughly. The active interest of the county agricultural agents and various farm and livestock organizations and the cooperation of competent local veterinarians are essential.

The question of reinfestation of the cleaned area naturally comes to mind. The greatest source of reinfestation would no doubt be untreated horses brought into the treated area, but this could be largely controlled. The distance the botflies can travel is a question which can not be settled easily. Although they may follow horses along roads for some distance, it seems very doubtful from our knowledge of the habits of the flies whether they go more than half a mile. It may be concluded safely that even though the bots are not completely eradicated from an area, the treatment, especially if conducted on a community basis, is very profitable. The treatment in such cases would of necessity have to be repeated when the botflies again became troublesome.

Undoubtedly systematic and thorough work as herein outlined would be profitable in any part of the United States, but its need is most felt in the North Central States and certain States of the Rocky Mountain region where the nose botfly has become thoroughly established. Such systematic work in the region infested by the nose botfly would give not only immediate large returns for the money and time invested, but if generally adopted would go far toward checking the spread of this most troublesome pest.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY